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ABSTRACT

Two research studies were designed to examine computer anxiety in teacher education students at West Virginia University. The studies explored the relationship between computer anxiety and performance, and the effects of both prior computer use and the instructional format on computer anxiety and performance. The first study was performed as part of a 6-hour, 1-day workshop designed to familiarize students with computer terminology, uses, and introductory programming. Fifteen participating students completed a computer anxiety instrument based on the Spielberger Self-Evaluation Questionnaire, and gave general background information including amount of prior computer use. Performance was measured on a 50-item, written, fill-in-the-blank test given at the end of the workshop. Results indicate that, although prior computer use does not affect computer anxiety or performance, instruction is effective in reducing computer anxiety. The second research study replicated the first precisely except that the 6-hour workshop took place in 2-hour blocks over the course of 3 consecutive weeks. Results indicate that the expanded instructional format did not significantly affect either computer anxiety or performance. A discussion of both of the studies concludes the paper. (12 references) (DB)

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THE EFFECTS OF BRIEF INSTRUCTIONAL ACTIVITIES ON TEACHER EDUCATION STUDENTS' COMPUTER ANXIETY AND PERFORMANCE

by

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INTRODUCTION

General Anxiety

Anxiety is a specific affective phenomenon which has long been considered an influential factor in education. Efforts to learn more about anxiety have resulted in a dramatic increase in related research in the past 10 years. Anxiety can be caused by exposure to new material, new teachers or new technologies and manifests itself in a variety of emotional and/or physiological forms ranging from an elevated heart rate to actual disorders. Anxiety may be real or imagined and can be learned (Wicks, 1977). People deal with their anxiety in different ways. Some simply cope with it and thereby learn to be less anxious in the future. Others employ defense mechanisms such as repression, projection, denial, and rationalization to overcome or avoid anxious situations in the future. These defense mechanisms all impair educational performance. According to Wicks, the best way to overcome anxiety and consequently reduce its detrimental effects on learning is by relaxation, reassurance, and learning to overcome the fear that causes anxiety.

Computer Anxiety

As mentioned earlier, an occasion for increased anxiety is exposure to new technology. Computers are a relatively new technology, rapidly becoming common-place in educational settings. Because it is estimated that 35 million people will be involved with computers by 1990 (Howard, Murphy, & Thomas, 1987), it is important to establish the best ways for teaching with and about computers. Although students generally respond positively to the computer as an instructional device and quickly master requisite skills, some students find the experience unpleasant or aversive (Marcoulides, 1988).

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Several tasks must be done before instruction can be designed to combat anxiety. First, a definition of computer anxiety must be established, in addition to determining the magnitude of its presence. A second step is to identify those attributes that either predict or have a significant relationship with anxiety. Finally, the design of treatments to reduce computer anxiety is necessary. Of course, to do this, a valid instrument to quantify anxiety must also be found or designed.

Review of Literature

Defining Computer Anxiety and Determining Its Presence

Rohner and Simonson (1981) define computer anxiety as "the mixture of fear, apprehension, and hope that people feel when planning to interact or when actually interacting with a computer" (p. 151). Howard, Murphy, and Thomas (1987) found that approximately one-third of students in two introductory computer groups (37% and 32%) had high computer anxiety. Likewise, Loyd and Gressard (1984) reported that as many as 25% of students experience some anxiety toward working with the computer. Research has shown that students and educators (Honeyman & White, 1987) perform computer tasks more poorly and develop negative attitudes as a result of computer anxiety. Finally, a study by Marcoulides (1988) found a strong negative relationship between computer anxiety and computer aptitude, literacy, and computer interest. In view of this research, we can safely say that people will be less interested in computers and will perform more poorly on computer-oriented tasks when their level of anxiety is high. With this in mind, it is clear that reducing computer anxiety must be considered when developing educational methods for computer-related tasks (Cambre & Cook, 1985). However, before we can design anxiety-reducing treatments, indicators of anxiety should be examined.

Indicators of Computer Anxiety

An interesting finding by Honeyman and White (1987) is that, contrary to popular belief, age and gender are not predictors of anxiety. However, experience using computers is (Loyd & Gressard, 1984). Marcoulides (1988) concluded that there is a statistically significant, though weak, negative relationship between computer anxiety and computer experience (those students with more experience in classroom uses of computer showed less anxiety toward computers).

Reed and Palumbo (1987/1988) also reported a negative relationship between computer experience and computer anxiety. In their study, the students specified prior computer use as (a) none, (b) using content-area software, (c) using managerial types of software such as word-processing and data base programs, and (d) programming languages. Reed and Palumbo rationalized that there were relatively greater degrees of involvement with computers, based on these uses. None clearly indicated no involvement. Running CAI-type software, according to them, required less involvement than using CMI-type software because, with CAI software, users usually respond to content-based prompts without adding any or very little to the progression of the program. With CMI-type software such as word-processing and spreadsheet programs, user-input increases. Although the users are working within the features of the program, they are using the program to create something--a letter, a report, and budget. It was believed by Reed and Palumbo that programming language-use involves the highest degree of involvement with the computer because the computer-supplied information is used as a tool with which to create something--a CAI-type program or a CMI-type program such as a data base.

Using their continuum-based notion of prior use, Reed and Palumbo (1987/1988) found a negative relationship between use and anxiety. Those students with no experience had greater anxiety than those who had used content-area software who were more anxious than those who had

used word-processing and data base programs. Of the four prior-experience groups, those with a programming background were the least anxious. Also in their study, Reed and Palumbo found a statistically significant, negative relationship between computer anxiety and performance measures of debugging, programming and prior experience in the BASIC programming language. In other words, those less anxious performed higher on the performance measures. They, likewise, found a statistically significant, negative relationship between problem solving ability and computer anxiety.

Instruction That Reduces Computer Anxiety

Computer anxiety is usually thought of as a temporary condition that can easily be affected through appropriate interactions and an environment structured to reduce the anxiety associated with using a computer (Torris, 1985). Studies show a reduction of anxiety after computer instruction. For example, Honeyman and White (1987) measured anxiety after 30 hours and 60 hours of CMI-type instruction. There was no significant reduction in anxiety after the first interval, but there was after 60 hours. Similarly, a study by Reed and Palumbo (1987/1988) found a significant decrease in anxiety after four weeks of a BASIC programming course which involved at least 36 hours of working with computers.

Measuring Computer Anxiety

An instrument to quantify the anxiety is necessary when conducting research. Researchers have identified general indicators or predictors of computer anxiety, one of which is locus of control: Coovert and Goldstein (1988) found that students classified as externalizers (those who tend to blame others for their situations) by Rotter's Instrument (1966) are likely to imply that the computer controls them. Similarly, Spielberger, O'Neil, and Duncan (1972) found that externalizers tend to experience high anxiety. The Computer Anxiety Scale, developed by Marcoulides, Rosen, and Sears (1985), predicts anxiety by the presence of specific situations.

However, when research is conducted to assess the effect of treatments on anxiety, an instrument to measure the magnitude of the anxiety is needed. Maurer and Simonson (1984) state that the Spielberger *Self-Evaluation Questionnaire* can accurately measure anxiety if administered at the appropriate time. Price (1985) conducted a study with two groups of teachers: (a) those receiving in-service instruction on computers and (b) those receiving in-service instruction without computers. She wanted to determine the degree of computer anxiety each group felt by administering the Spielberger instrument. She did not find significant differences between the two groups, even though one had had instruction on computers. She felt that the instrument, in its original form, did not adequately assess computer anxiety because the statements could easily be interpreted as general rather than computer oriented. With this in mind, Reed and Palumbo (1987/1988) modified the Spielberger instrument to specifically address computer issues. For example, "I feel tense" was changed to "I feel tense when I work with a computer." The format, a 20-question, four-point Likert scale, remained unchanged. The customized version has been reliable (coefficient alpha = .91 and .93) when quantifying anxiety levels based on prior computer experience, college major, and attitudes toward computer use in schools (Reed & Palumbo).

STUDY ONE

Rationale and Research Questions

Given the preponderance of computer anxiety and its potentially debilitative effects on the benefits of computer-based instruction, a logical consideration is to determine what type of and/or how little instruction is necessary to reduce anxiety. The reasoning is, if a minimal amount of

instruction can significantly reduce computer anxiety, then later computer-based instruction can focus on content, rather than building time into the instruction to alleviate computer anxiety.

Every semester at West Virginia University sophomores in the teacher education program must meet minimal computer competencies by attending a six-contact-hour Computer Awareness Module (CAM) and passing an exit test, or those students experienced with using computers--specifically with BASIC--have the option of pretesting out of the CAM requirement. Because the module involves a relatively little amount of instructional time, we believed it might identify the "least amount of instructional time" necessary for reducing computer anxiety--that is, if computer anxiety was significantly lower at the end of the six hours of instruction. Thus, our first research question was, ***What effect does a six-hour computer awareness module have on computer anxiety?***

Also at our disposal was demographic information about the teacher education students, specifically their prior computer use. Our second research question was, ***What effect does prior computer use have on computer anxiety?*** Because we tested them at the end of the instruction, we were interested in the relationship between computer anxiety and performance--that is, did lower computer anxiety correlate with higher performance? Thus, our third research question was, ***What is the relationship between computer anxiety and performance?*** Our final research question was, ***What effect does prior computer use have on performance?*** We believed that a more extensive background might benefit students more than the less extensive backgrounds of some of the other students.

Design of the Study

Sample

Every semester teacher education students at West Virginia University enrolled in all sections of an undergraduate educational psychology course must be processed for the Computer Awareness Module (CAM). Processing involves their completing a four-page packet: (a) a general student profile sheet (asking for major, gender, prior computer use); (b) a page for pretesters to complete if they wish to test out of the module requirement; (c) a page listing the days, dates, and times of the CAM sections for that semester; and (d) a computer anxiety instrument (they have the option not to respond to the instrument).

To accommodate the 150 to 200 students who might need the computer instruction, nine sections of the CAM are usually offered. The sample in this study consisted of 15 students who enrolled in one section of the nine CAM sections. A total of 20 students were enrolled in this section of the module, but only 15 completed the voluntary computer anxiety instrument, both before the treatment as part of the registration packet, and directly after the instruction.

Independent Variables

Treatment. The module, a six-hour, one-day (Saturday) session, was designed to familiarize students with computer terminology and uses, in addition to introductory programming in BASIC. It consisted of three, two-hour sessions followed by a one-hour test. The first session dealt with computer terminology, architecture, educational uses (CAI, CMI, and programming), and operational skills. The second session was a hands-on lesson focusing on simple graphics in lo-resolution Applesoft BASIC, including the appropriate DOS commands for loading, running, and saving programs. The third session, also hands-on, introduced simple TEXT programming, including screen formatting (INVERSE, FLASH, and SPEED=) and string and numeric variables. The most advanced command introduced was the FOR/NEXT pair used as a counting loop to delay program presentation.

Prior Use of Computers. The students identified their prior computer use on the survey they completed when they signed up for the module. There were four prior-use groups: (a) no computer experience (n = 4); (b) Computer Aided Instruction (CAI) which included any type of educational courseware used as an integral part of, or supplement to, a class (n = 3); (c) Computer Managed Instruction (CMI) which included software applications designed to aid the managerial tasks of teachers such as word processing, data base, grading programs and test generators (n = 5); and, (d) any programming languages (n = 3). If a student checked more than one category, he/she was placed in the higher one. For example, if CAI and programming languages were both checked, the student was placed in the programming language group.

Computer Anxiety. Computer anxiety was measured via the Spielberger instrument modified by Reed and Palumbo (1987/1988). It served as the independent, or predictor, variable when determining the relationship between computer anxiety and performance.

Dependent Measures

Computer Anxiety. Computer anxiety, as stated earlier, was measured via the Speilberger instrument.

Performance. A second dependent measure was the scores obtained on the written portion of the module test which consisted of 50 fill-in-the-blank and matching questions about the terminology, architecture, and educational uses of the computer. Also included in the first part was a test of knowledge about TEXT commands: A short program (10 lines) was given, and the student was required to describe accurately the function of each line. Also, as part of the exit test but not included in this measure were a system-operations exercise and a programming exercise involving lo-resolution graphics programming. (For a description of these parts of the test, see the note at the end of the paper.)

Analysis of the Data

To answer the research question, ***What effect does a six-hour computer awareness module have on computer anxiety?***, a paired t-test was performed, comparing the students' pre-instruction computer anxiety with their post-instruction computer anxiety.

To answer the research question, ***What effect does prior computer use have on computer anxiety?***, two ONE-WAY analyses of variance were conducted. In both analyses prior computer use--None versus CAI versus CMI versus Programming Language--served as the independent variable. In one analysis their pre-instruction computer anxiety was the dependent measure. In the other analysis their post-instruction computer anxiety was the dependent measure.

To answer the research question, ***What is the relationship between computer anxiety and performance?***, a simple regression was conducted, regressing test scores on computer anxiety.

To answer the research question, ***What effect does prior computer use have on performance?***, a ONE-WAY analysis of variance was performed with prior use as the independent variable and performance as the dependent measure.

Results

The Effect of the Instruction on Computer Anxiety

There was a significant decrease in computer anxiety from the pretest to the posttest: $t(14) = 4.79, p = .0003$ (see Table 1 for means and standard deviations).

The Effect of Prior Computer Use on Computer Anxiety

There were nonsignificant differences in computer anxiety across the four groups of computer experience at the beginning of the instruction: $F(3,11) = 2.21, p = .14$ (see Table 1).

There were significant differences in computer anxiety across the four groups of computer experience at the end of the instruction: $F(3,11) = 3.21, p = .06$ (see Table 1). Based on *post hoc* tests to determine actual differences, it was found that the anxiety of those with ***No Prior Experience*** was significantly higher than those whose background centered on ***Computer Managed Instruction***. There were no other significant differences.

The Relationship Between Performance and Computer Anxiety

There was not a significant, linear relationship between post-instruction computer anxiety and performance: $F(1,13) = .037, p = .89$ (see Table 1).

The Effect of Prior Use on Performance

There were nonsignificant differences in performance across the four groups: $F(3,19) = .399, p = .756$ (see Table 1).

Discussion

Reducing Computer Anxiety

The Instruction. As a group the instruction was effective at reducing computer anxiety. Such a finding is promising simply because the instruction was so brief. Because the students enrolled in the module will have computer components in later methods courses, they might be less apprehensive toward using computers which should help them perform better on these later computer-based tasks.

Prior Computer Use. When looking at prior computer use and its effect on pre-instruction and post-instruction computer anxiety, the only significant difference in anxiety was at the post-instruction point: between (a) those students with CMI experience and (b) those students with No Prior experience, CAI experience, and Programming Language experience.

It is interesting that at the pre-instruction point there were not significant differences across the four prior-use groups--that is, students of a wide range of computer experience had the same degree of computer anxiety. A possible explanation may be due to the "treatment-vacuum" often evident at pre-treatment data collection points when research-participants report their attitudes about a factor--a skill or an instructional device--such as computers without having experienced or recently used it. However, the post-instruction findings suggest that a CMI experience such as

word processing or data base may be the most beneficial prior-experience to have when enrolled in a brief period of instruction such as the CAM.

In some respects this finding and our explanation are still confusing because almost two-thirds of the instruction centered on programming in BASIC. The expected finding would be that those with a programming background would benefit the most. As stated earlier, some of the teacher education students opted to pretest out of taking the module. These students were ones who had had considerable experience in BASIC. So, through this process of elimination, the **module** students **with programming experience** were ones who felt their background in BASIC was either non-existent (i.e., it may have been in FORTRAN, COBOL, or Pascal) or not sufficiently extensive to pass the pretest. In the case of this study, programming language prior-experience may not have been the most successful experience among the module participants. In fact, the programming experience for some of them may have interfered with their learning of the module information--that is, if their background was in FORTRAN or even in IBM BASIC, they may have experienced frustration while learning another language or another version of BASIC than the one they had learned (the module involved, as stated earlier, Applesoft BASIC). Even though they had had some prior experience with a programming language, it might have been superficial or they may not have done well. In both cases, their anxiety toward computers may never have decreased from its level prior to the experience. Because those whose background was with CMI-type software could not opt to pretest (background in BASIC was a requisite), this type of prior experience may have been the most successful prior experience, as reflected by lower anxiety. A primary CMI-use is word-processing, a type of computer-use that is often not difficult to learn and usually rewarding.

As stated earlier, these 15 students attended only one of nine sections of the CAM in this particular semester and were among teacher education students in seven sections of an undergraduate educational psychology course, all of whom completed the sign-up packet. Based on this collection of information, we had the prior computer use and computer anxiety of all students for that semester, allowing us to compare the anxiety of all students according to their prior-use, including those with programming experience who had passed the pretest. When including the anxiety of the successful pretesters with the anxiety of the programming-background students who attended the module, the combined programming-experience students had significantly lower anxiety than any of the other prior-use groups. This finding has held true when analyzing prior-use groupings and computer anxiety from seven other semesters.

The Relationships Between Performance and Computer Anxiety and Prior Experience

The lack of a significant relationship between anxiety levels and performance scores indicates that anxiety does not predict performance. That is, by not having a linear relationship with performance, computer anxiety is not a predictor, indicating that high anxiety does not mean low performance or that low anxiety does not mean high performance. This is in contrast to existing research (i.e., Reed & Palumbo, 1987/1988). A more likely reason is that the module content was not difficult to master; and, therefore, test performance based on that content was not distinguishable by different degrees of computer anxiety, or that high anxiety did not negatively affect the learning of fairly simple information.

The lack of performance differences among the four computer experience groups further supports this line of reasoning. Despite their prior experience--None versus CAI experience versus CMI experience versus programming experience--post-instruction test scores were not significantly different. The performance means were (a) **no prior experience**, 90 (sd = 7.874); (b) **CAI**, 87 (sd = 6.083); (c) **CMI**, 90 (sd = 3.391); and, (d) **programming**, 91.67 (sd = 2.082).

Other Explanations

One reason for the lack of significant effects or relationships is the small sample size. The smallness of the sample is further confounded when we divided the sample into prior-use groups, reducing our cell size from the full-group of 15 to three, four, or five--depending on their prior-use. With larger cell populations the results might be different. Likewise, a lengthier treatment might have yielded different results--especially for those with different types of prior experience--but then, the purpose of this study was to investigate the effect of a brief exposure to computers.

STUDY TWO

Rationale and Research Questions

Because there were some significant findings in Study One, we decided to pursue yet another factor: **instructional format**. Instead of the one-day (Saturday) format, the educational psychology students could choose to attend a weekly module that met for two hours, one day a week, for three consecutive weeks--for example, from 1 p.m. to 3 p.m. on three consecutive Mondays, with the one-hour post-instruction test given on the fourth Monday. We wanted to determine whether having a longer period of time--that is, over a four-week period--to learn and process the information would produce different computer anxiety and performance results than the one-day format. Our research questions were, ***What effect does a different instructional format have on computer anxiety?*** and ***What effect does a different instructional format have on performance?***

Design of the Study

Sample

The sample (n = 16 in the weekly format; n = 18 in the one-day format) consisted of education majors enrolled in two other sections of the CAM during the same semester as those in Study One. The students completed the voluntary computer anxiety instrument (both pre-instruction and post-instruction), which was adapted by Reed and Palumbo (1987/1988), and the student profile sheet, as explained in Study One.

Independent Variable: Treatment

The module used in this study was identical to the one used in the first study with the following exception: The weekly group attended three two-hour sessions, each of which occurred on three consecutive Mondays; they took their test during a one-hour test-period on the fourth Monday. Each of the first three sessions covered one of the three module segments. The Saturday group received exactly the same material but attended a one-day session, as explained in Study One.

Dependent Measures

Computer Anxiety. Computer anxiety was measured using the Speilberger instrument modified by Reed and Palumbo (1987/1988).

Performance. The performance measure, the written portion of the module test, was also identical to that used in the first study.

Analysis of the Data

To determine whether one group, categorized by format (weekly versus one-day), had greater anxiety toward computers than the other at the onset, an unpaired t-test was run with format as the independent variable and pre-instruction anxiety as the dependent variable.

To answer the research question, ***What effect does a different instructional format have on computer anxiety?***, an unpaired t-test was run with format as the independent variable and post-instruction anxiety as the dependent variable.

To answer the research question, ***What effect does a different instructional format have on performance?***, an unpaired t-test was run with format as the independent variable and post-instructional test scores as the dependent variable.

Results

Computer Anxiety

There were no significant differences in computer anxiety between the one-day and weekly groups before the instruction: $t(32) = 1.135$, $p = .266$ (see Table 2). That is, the two groups had equivalent degrees of computer anxiety at the onset.

When comparing the post-instruction anxiety of the weekly and the one-day groups, there was not a significant difference: $t(32) = -.486$, $p = .6303$. However, when comparing the pre-instruction and post-instruction computer anxiety within each group, the weekly group significantly reduced their computer anxiety: $t(15) = 2.239$, $p = .0329$ (see Table 2). The one-day group did not: $t(17) = .415$, $p = .6806$ (see Table 2).

Performance

There were no significant differences in performance between the two groups: $t(32) = -.801$, $p = .429$ (see Table 2).

Discussion

Based on these findings, we can again infer that brief computer-awareness instruction can significantly reduce computer anxiety, as evidenced by the weekly-format group. The confusing finding is that the one-day format did not. This contradicts the finding in the first study, in which the one-day format did significantly reduce computer anxiety. It is not clear whether the finding in Study One is correct or the finding in Study Two is correct.

Despite the differences in computer anxiety between the weekly group and the one-day group, the two groups did not produce significantly different performance scores. This finding may be explained by using the interpretation in Study One: that the module content was not difficult to master and that one type of instructional format did not hinder performance any more or any less than the other. Having four weeks to process and learn the module information did not benefit the student more than having just one day to process and learn it. This supports our belief that the content was not very difficult.

CONCLUDING REMARKS

Although some of the results of both studies seemed to support the effectiveness of a brief period of instruction for reducing computer anxiety, some contradictions have surfaced. In Study One, the one-day format significantly reduced computer anxiety; in Study Two, the one-day format did not. Rather, the weekly format was the effective format in Study Two. It is not evident to us whether we committed a Type I error (rejected a null hypothesis when it should be accepted) in Study One or a Type II error (accepted a null hypothesis when it should be rejected) in Study Two. Only through additional research can we determine this. But, by continuing to use small samples, our findings--whatever they might turn out to be--may not hold up consistently. We have attributed the contradictory findings from Study One and Study Two to the small sample sizes. It does not make much sense to attempt another study, unless the sample size is much larger. Perhaps a better decision might be to replicate the two studies with much larger samples. During this semester, there are 10 module sessions: six following the weekly format and four following the one-day format. Approximately 150 students will enroll in these module offerings. Not only will we have a much larger number of students enrolled in the weekly versus the one-day format but also there will be larger numbers of students with various computer backgrounds. Within a given instructional format, we can still group them based on prior experience and have sufficiently large cell sizes that would enable us to interpret our results with more certainty. One potential shortcoming is that, because an artifact of the module-requirement is that students with sufficient backgrounds in BASIC can pretest out of the instruction, programming background may not be the most successful background. Certainly a larger sample size would allow us to be surer about this issue.

NOTE: In addition to the 50-item, objective written test, the students, upon completing the written portion, were then given a test disk and a list of directions which required that they insert the disk in the drive, boot the system, and transfer and execute a file from the disk to the memory of the machine. Once executed, the program informed them of the programming task and to raise their hand for additional programming instructions. After writing the program, they then saved it on the test disk under their names.

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Table 1. Computer Anxiety and Performance Means for Students with No Prior Computer Experience, CAI, CMI, and Programming Language (standard deviations given in parentheses)

	No Exper.	*CAI*	*CMI*	*Program. Language*
Measure	*n = 4*	*n = 3*	*n = 5*	*n = 3*
Computer Anxiety				
Pre-Instruction	56.75 (12.69)	52.33 (7.57)	38.6 (8.02)	47.33 (15.50)
Post-Instruction	49.0 (11.97)	44.67 (8.96)	28.8 (11.26)	40.33 (5.51)
Performance	90.0 (7.87)	87.0 (6.08)	90.0 (3.39)	91.67 (2.08)

Table 2. Computer Anxiety and Performance Means for Students in the One-Day and Weekly Instructional Formats (standard deviations given in parentheses)

	One-Day Format	*Weekly Format*
Measure	*n = 18*	*n = 16*
Computer Anxiety		
Pre-Instruction	48.44 (12.29)	53.13 (11.66)
Post-Instruction	46.72 (12.59)	44.86 (9.03)
Performance	82.67 (10.93)	78.88 (16.41)